**ACADEMIA JOURNAL OF BIOLOGY** 2020, 42(2): 35–40
DOI: 10.15625/2615-9023/v42n2.14846

# FOOD SELECTION OF MAIZE WEEVIL *Sitophilus zeamais* (Motschulsky)

**Nguyen Van Dzuong[1,2,*], Khuat Dang Long[3]**

[1]Tay Bac University, Son La City, Vietnam
[2] Graduate University of Science and Technology, VAST, Vietnam
[3]Institute of Ecology and Biological resources, VAST, Vietnam

Received 24 February 2020, accepted 15 April 2020

## ABSTRACT

The instintive behaviour exhibited by insects in the selecting food is always a matter of interests to entomologists, and it is one of the fundamental principles underlining the application of entomology to agriculture, horticulture and forestry. Food seclection is an important characteristic of insects that help them survive in periods with insufficient foods.

Three grain types of food, maize grain, long-grain rice and soybean grain, were used in this sudy for detecting food selection behaviours of maize weevil, *Sitophilus zeamais*. Grains were kept in box traps put in the different stores in Son La during 90 days. The result showed that maize weevil, *Sitophilus zeamais*, prefered traps with maize grains (71.4%) considerably more than ones with long-grain rice (14.3%) and soybean grain (14.3%). Meanwhile, the cornsap beetle, *Carpophilus dimidiatus*, was mostly observed in maize grain (98.5%) and to a lesser degree, in soybean grain (1.5%); and the dried-fruit beetle, *Carpophilus hemipterus*, was abundantly observed in maize grain (93.1%) and less in soybean grain (6.9%). The red flour, *Tribolium castaneum*, also tended to select all the three food grain, i.e. maize grain: 53.5%, long-rice grain: 35.2%, and soybean grain: 11.3%.

Comparing beetle individuals captured on three types of food grains showed that the maize weevil, *Sitophilus zeamais*, is the most abundant species. The percentage this store beetle among all beetles observed in maize, soybean grains and long-rice grains were 57.0%, 84.9% and 27.6%, respectively. Interestingly, *Ahasverus advena*, foreign grain beetle, occurred abundantly on long-rice gain (61.7%), i.e. this grain is a suitable food for the development of this beetle.

**Keywords**: *Sitophilus zeamais*, food selection, maize, store insect pests, Vietnam.

*Citation*: Nguyen Van Dzuong, Khuat Dang Long, 2020. Food selection of maize weevil *Sitophilus zeamais* (Motschulsky). *Academia Journal of Biology*, 42(2): 35–40. http://doi.org/10.15625/2615-9023/v42n2.14846.

**Corresponding author email*: duongdhtb@gmail.com

## INTRODUCTION

Food selection is one of the biological characteristics of insects. Food selection is closely related to the biological behaviours, physiology and the special structure of insects (Brues, 1920; Rajendran, 2005). Food selection plays an important role in the individual development of each insect species. Particularly, when a source of food is scarce or depleted, insects can find other less preferred food sources to maintain population development.

Grain weevils made up a significant portion of insect pests in granaries (Nguyễn Quang Hieu et al., 2000; Tran Bat Khuat & Nguyen Quy Duong, 2005; CABI, 2010; Bui Cong Hien et al., 2014). Controlling these insects is difficult due to restriction on using harmful insecticides, abundance of food for pests in granaries, continous transport of argricultural products in and out the granaries, and difficulties in maintaining periodic cleaning. Hence, while grain weevils are always present in granaries at a low number, their population can increase uncontrollably with sufficient food.

Due to these practical concerns, in this study, experiments were conducted to study the food selection behaviours of insects inside maize granaries in Son La to determine the favourite food of *Sitophilus zeamais*, a pest in maize granaries.

## MATERIALS AND METHODS

Food traps were used in this study with three weevil food type, including maizes (NK 7328 strain), long-grain rice (Thai strain) and soybeans (local strain). All food was homogeneously processed at 60ºC for 20 minutes, then left indoors for 7 days before transferring to closed containers to maintain a stable water ratio for long term experimental use.

Small bags, 25×15 cm in size, with baits were used for trapping. Experimental equipments include grain drying cabinets, Dickey-John grain moisture tester, Hair Hygrometer (with ± 1% precision), and Olympus SZ61 stereo microscope. Maize, rice and soybean grains were weighted and split in bags, 300 g each.

Traps were set in granaries distant from each other at Co Noi commune, Mai Son district, Son La province; where several maize granaries were present. Inside each granary, three positions were chosen. At each of them, three food samples, one of each grain type, were placed so that pests had easy and similar access to them. Every 5 days, bags were collected to count the number of pests. Food were then replaced and put back at previous positions. The experiments were repeated for 3 months (March to May, 2019). For every sample, the number of each weevil species inside was counted. All grain weevil samples were preserved in 90% alcohol and store at Center for Applications and Experiments, North Western University, and identified following Bui Cong Hien et al. (2014).

Percentages of grain weevils captured in food types were counted in the following fotmula:

$$\text{Percentages} = n(a)/N \times 100$$

*Where*: n(a)=the captured adults of each species; N=the adults of all species captured in each food type.

## RESULTS AND DISCUSSION

In experiments for three months (from March to May) with 3 types of grains, including maize, rice and soybean, placed inside maize granaries at Co Noi commune, Mai Son district, Son La, common weevils species found in maize samples were *Sitophilus zeamais, Tribolium castaneum, Carpophilus dimidiatus, Carpophilus hemipterus* and *Ahasverus advena*; while *Sitophilus zeamais, Tribolium castaneum, Carpophilus hemipterus,* and *Ahasverus advena* were frequently present in rice samples. In soybean samples, *Sitophilus zeamais, Tribolium castaneum, Carpophilus dimidiatus* and *Ahasverus advena* were common. Besides, several other species found in maize and rice grain samples at a low number (these were grouped together) were not present in soybean samples (Table 1).

*Table 1.* Comparison of number of individuals of grain weevils in three food type (Mai Son, Son La March-May 2019)

| Grain weevil species | Number of beetle adults captured | | | | | |
|---|---|---|---|---|---|---|
| | Maize grain | | Long-grain rice | | Soybean grain | |
| | Number of individuals | Percentage (%) | Number of individuals | Percentage (%) | Number of individuals | Percentage (%) |
| *S. z.* | 588 | 57.0 | 118 | 27.57 | 118 | 84.89 |
| *T. c.* | 38 | 3.69 | 25 | 5.84 | 8 | 5.76 |
| *C. d.* | 133 | 12.90 | 0 | 0.0 | 2 | 1.44 |
| *C. h.* | 94 | 9.12 | 7 | 1.64 | 0 | 0.0 |
| *A. a.* | 122 | 11.83 | 264 | 61.68 | 11 | 7.91 |
| Others | 56 | 5.43 | 14 | 3.27 | 0 | 0.0 |
| Total | 1031 | 100 | 428 | 100 | 139 | 100 |

*Abbreviations: S. z.: Sitophilus zeamais; T. c.: Tribolium castaneum; C. d.: Carpophilus dimidiatus; C. h.: Carpophilus hemipterus; A. a.: Ahasverus advena*.

Figure 1 showed food selection of different grain weevil species found in maize granaries in Son La. The maize weevil, *Sitopilus zeamais*, were found in all three food types but mostly in maizes (71.4%). Its presence in the other two food types were equal, both at 14.3%. While *Tribolium castaneum* were found in maize (53.5%), long-grain rice (35.2%) and soybean (11.3%); *Carpophilus dimidiatus* were found only in maize (98.5%) and soybean (1.5%). *Ahasverus advena* mostly preferred rice (66.5%) followed by maize (30.7%) and soybean (2.8%). *Carpophilus hemipterus* were only present in maize (93.1%) and rice (6.9%). Similary, for the other grain weevils, 80% were found in maize and 20% were found in long-grain rice.

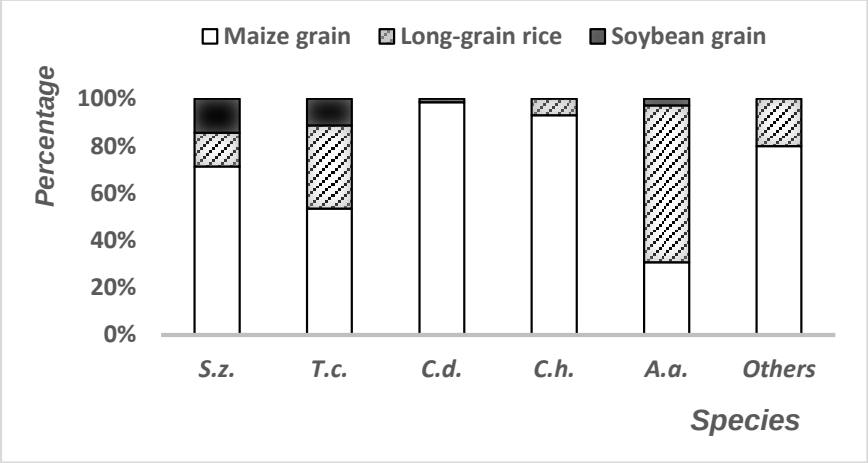


*Figure 1.* Percentages of grain weevils found in three food types (Mai Son, Son La, March-May 2019). Abbreviations: *S. z.*: *Sitophilus zeamais*; *T. c*: *Tribolium castaneum*; *C. d.*: *Carpophilus dimidiatus*; *C. h.*: *Carpophilus hemipterus*; *A. a.*: *Ahasverus advena*.

In maize samples, 5 species were most common (Fig. 2). Among them, the maize weevil Sitophilus zeamais took up 57.0% while Tribolium castaneum were the least abundant, only 3.69%. The three others, *Carpophilus dimidiatus*, *Ahasverus advena*

and *Carpophilus hemipterus*, were equally found, at 12.9%, 11.83% and 9.12%, respectively. Other infrequently found species only made up 5.43% (Fig. 2).

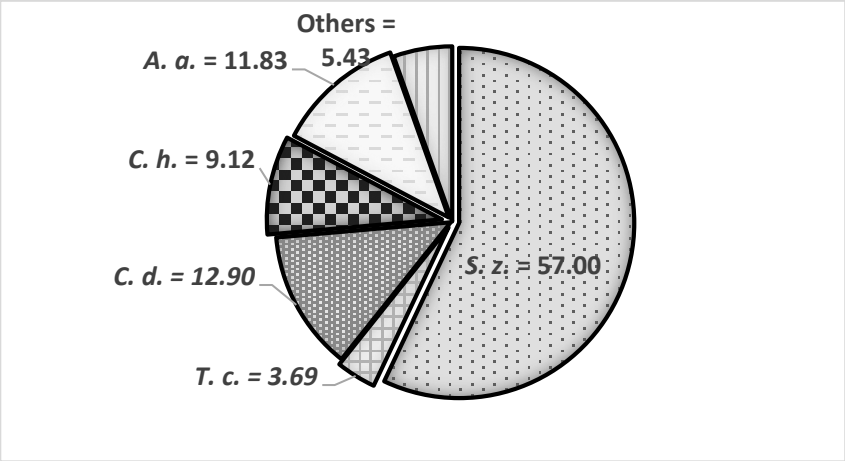


*Figure 2*. Percentages of grain weevils in maize (Mai Son, Son La, March-May 2019). Abrreviations as in Fig. 1

Among the 4 common grain weevil species in rice samples, *Ahasverus advena* was the most abundant (61.68%). The percentages of other less common species, including *Sitophilus zeamais*, *Tribolium castaneum* and *Carpophilus hemipterus* were 27.57%, 5.84% and 1.64%, respectively. Other uncommon species made up only 3.27% (Fig. 3).

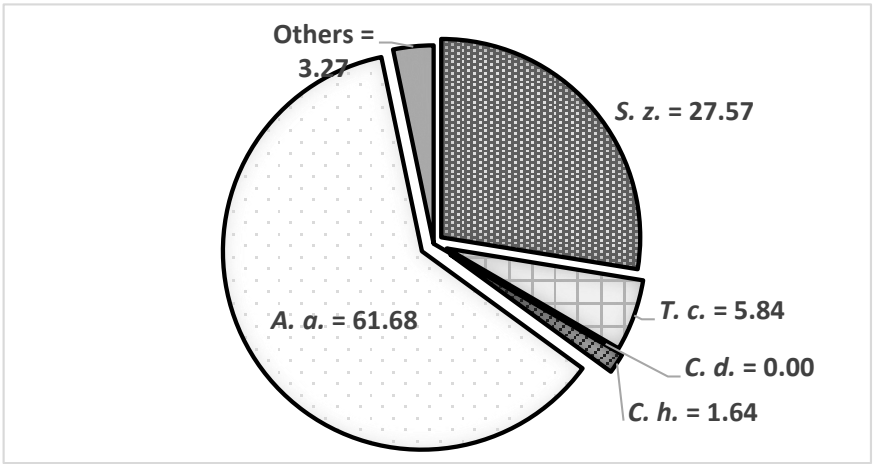


*Figure 3.* Percentages of grain weevils in long-grain rice sample (Mai Son, Son La, March-May 2019). Abrreviations as in Fig. 1

In soybean samples, only 4 species were found. Sitophius zeamais were dominant (84.89%) while the 3 other species, *Ahasverus advena*, *Tribolium castaneum* and *Carpophilus dimidiatus* were much less present, at 7.91%, 5.76% and 1.44%, respectively (Fig. 4).

Results show that in granaries at Son La, during the March to May period, while maize grains were not present, 5 important maize weevil were still existing with *Sitophilus zeamais* being the dominant, while the others were less common.

Among weevil species commonly found in samples of three food types, *Sitophilus zeamais* was dominant in maize and soybean samples while *Ahasverus advena* was dominant in rice samples. Particularly, *Carpophilus dimidiatus* was not present in rice but in maize (12.90%) and soybean (1.44%); *Carpophilus hemipterus* was not found in soybean but in maize (9.12%) and rice (1.64%).

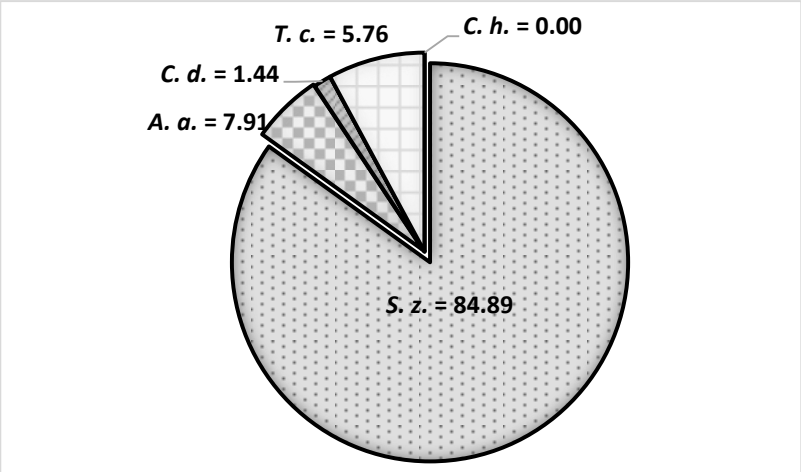


*Figure 4.* Percentages of weevils found in soybean samples (Mai Son, Son La, March-May 2019). Abbreviations as in Fig. 1

Comparing samples of three food types (Fig. 1), in terms of numbers of individuals, *Sitophilus zeamais* is significantly more abundant in maize than in rice and soybeans combined (588 vs 118 adult insecsts, respectively). It can therefore be confirmed that the maize weevil, *S. zeamais*, usually prefer maize over other types of grains.

In case of *Ahasversus advena*, rice can be considered its preferred food (264 adult insects) over maize (122 adult insects) and soybean (11 adult insects). Other weevil species mainly prefer maize, followed by rice, with soybeans selected by few to none (Fig. 1).

Analyzing number of individuals of five grain weevils found in traps with three types of food (maize, rice and soybean) with the same water proportion, it can be realized that in granaries in Son La, even after maize grains have been removed, these 5 species are still considerably common in granaries. Adult weevil were still able to live with the very small residual number of grains, and they still tended to seek their preferred food type for laying eggs and maintain development. This food selection characteristic of *S. zeamais* is quite event among the grain weevils found in Son La.

## CONCLUSIONS

In maize grain granaries in Son La, 5 weevil species, including *Sitophilus zeamais*, *Ahasverus advena*, *Carpophilus dimidiatus*, *Carpophilus hemipterus*, and *Carpophilus dimidiatus*, frequently appear among maize grains with high ratios. Meanwhile, only 4 were encountered in rice and soybean samples. Moreover, among these three types of food, other weevils were present at insignificant proportions.

In maize grains, *S. zeamais* occupied a much higher percentage than in rice and soybeans, while A. advena were dominant in rice but rarely found in maize and soybeans. Other species were less present in rice and soybean but more common in maize.

In the scattered granaries at Son La, prevention of grain weevils is usually more difficult than in centralized granaries. The

most applicable and effective method to preserve maize grains is granary cleaning and isolation before transferring grains to the granaries; seperating maize granaries from other agricultural products and animal feeds, which are sources of weevils that can penetrate maize granaries.

**REFERENCES**

Brues C., 1920. The Selection of Food-Plants by Insects, with Special Reference to Lepidopterous Larvae. *The American Naturalist*, 54(633): 313–332.

Bui Cong Hien, Trinh Van Hanh, Bui Tuan Viet, Nguyen Quoc Huy, 2014. Animal pests in granaries and houses. Agricultural Publishing House, 186 pp. (in Vietnamese).

Bui Minh Hong, Ha Quang Hung, 2004. Ingredients of weevil species and its natural enemy on preserved paddy piled up in the arch warehouse of the National Reserve Department of Hanoi and its vicinity. *Journal of Plant Protection*, no. 2: 3–6 (in Vietnamese with English summary).

CABI, 2010. *Sitophilus zeamais* (maize weevil) datasheet. Crop Protection Compendium, 2010 Edition. CAB International Publishing Wallingford, UK. www.cabi.org/cpc (acessed on 28 Jan. 2020).

Dinh Ngoc Ngoan, 1964. Results of a survey of insect pests in northern Vietnam. *Vietnam Journal of Agricultural Scienses*, no. 4: 115–121 (in Vietnamese with English summary).

Nguyen Kim Hoa, Nguyen Van Liem, Tran Thi Huong, Nguyen Thi Hien, 2008a. Main biological characteristics of the corn weevils *Sitopphilus zeamais* Motch. (Col: Curculionidae). Proceedings of the Sixth National Conference on Entomology, Agriculture Publishing House. H.: 560–569 (in Vietnamese with English summary).

Nguyen Kim Hoa, Nguyen Van Liem, Tran Thi Huong, Nguyen Thi Hien, 2008b. Ingredients and extent of harm of the weevils in maize preserved in households in Bac Ha and Lao Cai. The 6th National Conference of Insects, Agriculture Publishing House H.: 634–638 (in Vietnamese with English summary).

Nguyen Quang Hieu, Luong Thi Hai, Bui Cong Hien, 2000. Some results of survey on insect pests stored paddy in Ha Noi and Hai Phong. *Journal of Plant Protection*, no. 5: 11–14 (in Vietnamese with English summary).

Nguyen Quy Duong,Vu Thi Hai, Nguyen Viet Hai, Le Nhat Thanh, Ho Thi Xuan Huong, Vu Quang Con, 2009. Ingredient of insect pests on post-harvest pea in Northern Vietnam 2006–2008. *Journal of Plant Protection*, No. 2: 11–17 (in Vietnamese with English summary).

Rajendran S., 2005. Detection of insect infestation in food commodities. *Advances in food and nutrition research*, 49(4): 163–232. https://doi.org/10.1016/S1043-4526(05)49005-1.

Tran Bat Khuat, Nguyen Quy Dzuong, 2005. Ingredient of peanut pests in storage in some areas in 2004. *Journal of Plant Protection, no.* 1: 11–15 (in Vietnamese with English summary).